COMSEARCH
An Alliance Telecommunications Company

June 2, 1992

Ms. Donna R. Searcy
Secretary
Federal Communications Commission
1919 M Street, NW
Washington, DC 20554

RE: In the Matter of Redevelopment of Spectrum to Encourage Innovation in the Use of New Telecommunications Technologies, ET Docket No. 92-9

Dear Secretary Searcy,

Enclosed herewith is one (1) original, and 5 (five) copies of our response to the Emerging Technologies Docket No. 92-9.

Sincerely,

COMSEARCH

H. Mark Gibson
Senior Engineer, PCS Development

HMG:me

enclosures

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Before The
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter Of	)	
	)	
Redevelopment of Spectrum to	)	
Encourage Innovation in the	)	ET Docket No. 92-9
Use of New Telecommunications	)	
Technologies	)	

TO: The Commission

Table of Contents

SUMMARY

COMSEARCH agrees with the need to establish new areas of the spectrum for emerging telecommunications technologies. We further agree that spectrum in the 1.85 - 2.20 GHz band should be made available. However, existing licensees in this band must be accommodated in a manner that is least disruptive to the services that these users are providing.

We generally agree with the results of the OET Spectrum Study, although earth stations were not considered in the determination of the amount of available spectrum in the transition bands. However, through the use of proper frequency coordination techniques, it will be possible to accommodate existing users in these transition bands. We have conducted studies in several large cities, the results of which indicate that paths in the 1.85 - 1.99 GHz band can be successfully migrated into the 6.525 - 6.875 GHz band. The results of a study we conducted in Houston, TX have been included as an example. While these studies concentrated on only these two bands, we believe that there is sufficient spectrum available in the other fixed microwave bands above 3 GHz to accommodate users currently in the entire 1.85 - 2.20 GHz band.

To facilitate the transition, we propose that the Commission drop the eligibility requirements of the fixed microwave bands above 3 GHz, and that frequency coordination be required in these bands. However, to accommodate both narrowband and wideband needs, we

propose that all the fixed microwave bands above 3 GHz be rechannelized to support narrowband and wideband operations. This rechannelization effort in conjunction with development of associated interference criteria and coordination procedures must be addressed promptly. We propose the Commission and the industry work together closely to insure the adequacy of new technical standards and the rules that will enforce them.

We also recommend that the Commission offer incentives to any microwave operators who consider vacating the 1.85 - 2.20 GHz band. We further believe that coordination procedures in the 1.71 - 1.85 GHz government band will make non-government sharing of this band extremely difficult.

Our measurements and computer modelling indicate that band sharing is feasible between PCS users and current users of the 1.85 - 1.99 GHz band. Therefore, current users of the 2 GHz band should be able to remain co-primary with new users of the band, relying upon proper frequency coordination techniques to promote band-sharing. Indeed, the 10 - 15 year period proposed by the Commission will see a majority of the frequency sharing problems resolved between new and existing users of the band.

We caution against the use of a phased approach to allocations until the Commission considers the spectrum requirements of the different proposed PCS access technologies. In addition, since there are locations in the band where current usage is not as heavy as in other locations, we urge the Commission to consider

carefully where in the band allocations are to occur so as not to give advantages to those receiving allocations where the spectrum is lightly used.

INTRODUCTION

COMSEARCH, an Alliance Telecommunications Company, hereby respectfully submits these comments in the above-captioned proceeding.

COMSEARCH has been coordinating frequencies and engineering microwave paths, earth stations, and mobile systems for over 15 years. Our experience working in the Operational Fixed (OF) and the Common Carrier (CC) microwave bands is perhaps unmatched.[1] In preparing for the deployment of emerging technologies in the 1.85 - 2.20 GHz bands, we have relied upon this experience to develop extensive computer models and perform actual field and laboratory measurements. The results of our modelling and measurements compel us to draw an important conclusion: spectrum sharing between emerging technologies and existing users in the 1.85 - 2.20 GHz bands is indeed feasible; however, proper engineering and frequency planning are paramount.

Our comments will indicate how we have arrived at this conclusion. In addition, we will comment on the OET Spectrum Study[2], the proposed reallocations, and the transition plan.

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[1] COMSEARCH has well over 150 years of collective experience in the engineering, design, and frequency coordination of microwave and mobile communications systems.

[2] "Creating New technology Bands for Emerging Telecommunications Technology," FCC OET/TS91-1 (January, 1992).

OET SPECTRUM STUDY

In general we agree with the results of the OET Spectrum Study. However, this study must be viewed as a heuristic approach to the very complicated problem of determining the amount of available spectrum.

It is imperative to point out that the OET study did not consider earth stations in either the 4 GHz or 6 GHz CC bands. The existence of earth stations in these bands is a good example of dissimilar services sharing the same spectrum. In the 4 GHz band, receive earth stations can be interfered with by terrestrial microwave transmitters. In the 6 GHz band, transmit earth stations can interfere with terrestrial microwave receivers. In addition, earth stations are coordinated to use the full band as well as the full arc. Therefore, earth stations can tend to present complicated frequency coordination problems.

Using the methods described in the OET study[3], we tallied the number of T/R (transmit/receive), T/O (transmit-only), and R/O (receive-only) earth stations located in the top 50 MSA's. If we look at New York as an example, there are 353 total 4 GHz and 255 total 6 GHz earth stations. Therefore, the remaining capacity by way of the OET study should be -449.[4] The complete results are shown in Appendix A.

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[3] Ibid. §4.4.4, para 2

[4] Ibid. Table 4. The total remaining capacity in New York before adding earth stations is 129. Subtracting the total 4 GHz (353) and 6 GHz (225) earth stations from 129 gives a remaining capacity of -449.

This number would seem to indicate that there is little additional spectral room in New York for additional users, including microwave and earth stations. Of course, this is not true. The key to locating additional stations in congested areas is proper frequency engineering.

We have conducted studies in several top MSA's to determine the extent to which paths in the 1.85 - 1.99 GHz band can be relocated into the 6.525 - 6.875 GHz band. The results of these studies indicate that in all markets, practically every path can be relocated to the higher band with similar reliability. To illustrate this, we have included the results of a study we conducted for Houston, TX. The purpose of this study was to determine how many paths in the 1.85 - 1.99 GHz OF band could be relocated into the 6.7 GHz OF band, and under what conditions (i.e., antenna upgrades, filter upgrades, etc.). We selected Houston due to the high number of paths in the 1.85 - 1.99 GHz band.[5] The results of this study indicate that of the 107 microwave paths in the 1.85 - 1.99 GHz OF band, all but 4 could be relocated into the 6.7 GHz OF band. To do so will required six filter upgrades and seven antenna upgrades. The upgrade antennas required were the minimum necessary FCC Standard-A pattern. The filters used were the minimum necessary to meet interference objectives. Although the study examined only the 1.85 - 1.99 GHz band, and looked at migrating into only the 6.525

[5] Houston has 107 microwave paths in the 1.85 - 1.99 GHz band. This is second only to Los Angeles which has 140 microwave paths in this band.

- 6.875 GHz band, we believe that there is sufficient spectrum in the bands above 3 GHz to accommodate users of the entire 1.85 - 2.20 GHz band. The complete study is provided in Appendix B.

Based upon the results of this study, and based upon our experience working in each of the frequency bands discussed in the Notice of Proposed Rulemaking, ET Docket No. 92-9 (NPRM)[6], we agree with the conclusion that there is available spectrum in these bands to accommodate users in the 1.85 - 2.20 GHz band. However, we must emphasize that little success will be realized in effecting such relocations without proper spectrum management and frequency engineering.[7]

PROPOSED REALLOCATIONS

In the NPRM, the Commission has proposed a blanket waiver of the eligibility requirements of all fixed microwave bands above 3 GHz for all existing fixed 2 GHz microwave users. In addition, the Commission has further proposed to maintain the coordination procedures that apply respectively to the CC and OF microwave bands. The Commission has also indicated that they will encourage licensees with path lengths less than 10 miles to

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[6] Specifically: the 1.85 - 1.99, 2.1 - 2.2, 3.7 - 4.2, 5.925 - 6.425, 6.525 - 6.875, 10.7 - 11.7, 11.7 - 12.2, 12.7 - 13.25, and 17.7 - 19.7 GHz bands

[7] While the results of our study are encouraging, it is important to mention some of the limitations. The study looked at only the 1.85 - 1.99 GHz band, and not at the full 1.85 - 2.20 GHz band. We were also able to control the order in which paths were migrated, concentrating on the worst-case ones first. This allowed us to minimize the effect that relocated paths would have on each other. Finally, the study did not account for growth in either the paths being relocated or in the existing 6.7 GHz band.

select bands higher than 10 GHz for relocation.[8]

We strongly support a blanket waiver of the eligibility requirements of the fixed microwave bands above 3 GHz; and we propose that the waiver apply to everyone and not just to the existing 2 GHz users. Indeed, we propose that the Commission dissolve entirely the distinctions between OF and CC for the purposes of band allocation.[9] However, to be successful, the OF and CC bands should be rechannelized to accommodate both narrowband and wideband applications, and prior coordination (as defined in 47 C.F.R. §'s 21.100 & 21.706) should be required in all bands. Should the Commission decide not to remove the barriers of distinction between the Common Carrier and Private bands, we still recommend implementing a frequency coordination process. The success of frequency coordination as defined under Part 21 of the rules is a testament to the efficiency this process adds to spectrum management.

Presently, the CC bands above 3 GHz are channelized for 20 - 40 MHz channels, and the OF bands above 3 GHz are channelized for

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[8] NPRM, at para. 20.

[9] The microwave industry has several technical and administrative bodies that are capable of addressing the process of rechannelization and coordination with the FCC. Two such bodies are the Telecommunications Industry Association (TIA) and the National Spectrum Managers Association (NSMA). Through these bodies and others, the industry has a good track record in generating the necessary technical standards and self-policing through the coordination process established in 47 C.F.R., §21.100.

5 - 10 MHz channels.[10] Most OF applications do not have sufficient capacity to require even a 20 MHz channel.[11] In addition, many OF users argue that narrowband requirements must be met, and that to do so with the existing channel arrangements in both the OF and CC bands above 3 GHz would be inefficient.[12] Rechannelizing all bands above 3 GHz to accommodate both narrowband and wideband operations would thus facilitate relocating from the 1.85 - 2.20 GHz band. However, rechannelization must be carried out in an orderly manner that addresses the needs of wideband and narrowband operation.[13] The microwave industry has been quite successful in developing and implementing band channelization schemes. We urge the Commission to rely upon the industry to suggest proper band channelization schemes.

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[10] The CC bands are channelized as follows: the 3.7 - 4.2 GHz band is channelized for 20 MHz channels, the 5.925 - 6.425 GHz band is channelized for 30 MHz channels, and the 10.7 - 11.7 GHz band is channelized for 20 or 40 MHz channels. Excluding the bands above 10.7 GHz, the OF bands are channelized as follows: the 6.525 - 6.875 GHz band is channelized for 5 and 10 MHz channels, and the 10.5 GHz band is channelized for 1.5 and 2.5 MHz channels (this band is also shared with CC).

[11] In many cases, the authorized channel capacity will never be approached by the reality of user's requirements, including allowances for growth. This would indicate that rechannelization could provide a more appropriate fit between user requirements and bandwidth authorization, which leads to more efficient use of the spectrum.

[12] See Petition For Rulemaking, UTC, RM-7981, at pp. 10 - 12.

[13] For example, 47 C.F.R., §21.122 specifies minimum voice loading requirements for the 3.7 -4.2, 5.925 - 6.425, & 10.7 - 11.7 GHz bands (1152 encoded voice channels). This would need to be modified to specify minimum loading based upon bandwidth of operation.

Band-sharing among OF and CC users is currently being effectively accomplished. Indeed, the last bands allocated (i.e., the 10.6, 18, and 23 GHz bands) are being shared successfully among OF and CC users. The channel plans in these bands support requirements from 1.5 MHz up to 50 MHz. For example, the 18 GHz band has been channelized to accommodate 5, 6, 10, 20, 40, 80, and 240 MHz requirements.[14]

The success that sharing has enjoyed so far in these bands is a result of proper frequency coordination. As users begin to relocate from the 1.85 - 1.99 GHz band into the other available bands, and as users design new systems in these bands, the task of finding available frequencies will become more critical. Frequency coordination will be key in ensuring that all frequency needs are met, and that enough spectrum is available to accommodate these new systems.

We are also in favor of encouraging the use of higher frequency bands for operations with short path lengths. The current FCC rules specify minimum path length requirements for given bands.[15] We recommend dropping the minimum path length

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[14] Another example of a band that has been channelized to meet narrowband and wideband requirements is the 38 GHz band in the U.K. This band is being used to effect network connections for the PCN systems in the U.K. The band can support 3.5, 7, 14, 28, 56, and 140 MHz channels.

[15] See 47 C.F.R., §'s 21.710 & 94.79. These rules specify the following minimum path length requirements: 1.85 - 2.11 GHz: 17 km; 2.11 - 2.13 & 2.16 - 2.18 GHz: 5km; 3.7 - 4.2, 5.925 - 6.425, & 6.425 - 7.125: 17km, and 10.7 - 11.7 & 12.2 - 13.25 GHz: 5km.

requirements for paths operating in bands above 10.7 GHz. We agree that this should tend to preserve the *general* availability of spectrum in the lower bands.

We are also in favor of enforcing EIRP and transmit power limitations.[16] Paths operating with excessive EIRP's not only make coordination difficult, they extend frequency reuse distances. The key to frequency coordination is the ability to reuse frequencies in a given area. Enforcing the EIRP and transmit power limitations will also help to preserve the availability of spectrum in all bands.

The Commission has indicated that it will offer incentives (in the form of tax certificates) to microwave operators who consider using other non-radio media to meet their communications needs, particularly fiber.[17] It could be viewed as prejudicial to offer incentives only to those choosing to move to non-radio media. The intent of this proceeding is to encourage innovation in the use of new telecommunications technologies, not to place the radio industry at an unfair competitive advantage. While we agree that the capacities of fiber greatly exceed those of microwave, it is possible that for many OF microwave operators, using fiber to address their communications needs may be a bit excessive. In addition, fiber offers specious rewards. Fiber cable cuts (typically called *backhoe fades*) can cause fiber

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[16] See 47 C.F.R., §'s 21.107 & 94.73.

[17] NPRM at para. 20, footnote 17.

circuits to be unavailable for several hours. Compared to the operating reliability that most microwave paths enjoy, outages of several hours are unheard of, and indeed unacceptable.[18] Microwave also affords operators the ability to implement systems when and where they desire, and to have control over the speed of implementation. Therefore, we encourage the Commission to consider offering incentives to all microwave operators planning to relocate from the 1.85 - 2.20 GHz band, and not just to those moving into fiber.

The Commission has also requested comments on the feasibility of making a portion of government spectrum the 1.71 - 1.85 GHz band available for relocation of some 2 GHz operations.[19] The NTIA is responsible for allocating spectrum in this band. In this capacity, the NTIA has issued a report on the use of the spectrum in this band.[20] Excerpts of this report concerning the use of the 1.71 - 1.85 GHz band are provided below for convenience:[21]

> "Specific agency applications of fixed services include: FAA remote data transmission in support of aviation, Army tactical radio relay systems to support an area-wide command and control network, Departments of Agriculture and Interior backbone links for control of land mobile radio systems

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[18] An outage of 8 hours corresponds to a yearly availability of 90.9086758%. Most microwave paths operate with a total per-hop availability objective better than 99.998%, which corresponds to a yearly outage time of about 10.5 minutes (source: Microwave System Engineering, AT&T Long Lines, 1976).

[19] NPRM at para. 21.

[20] National Telecommunications and Information Administration, Federal Spectrum Usage of the 1710 - 1850 and 2200 - 2290 MHz Bands, NTIA TR 92-285. This document has been placed in the ET Docket 92-9 file.

[21] Ibid., pp. 4-1 & 4-2.

> necessary in fire fighting, law enforcement, and disaster control within national forests ... and Department of Treasury and Justice microwave links related to law enforcement.
>
> This band is also used for a variety of mobile applications, including airborne telemetry, telecommand, automated target scoring, and air combat maneuvering instrumentation.
>
> The Air Force also uses the band for space telemetry, command and control. ... Telemetry and telecommand and control of the NASA Space Shuttle is conducted on space-to-space links in this band.
>
> This band is also used by the U.S. Coast Guard for vessel traffic safety systems, in support of the VHF National Distress System, and remote distress and safety communications and control networks."

The report indicates that there were 5590 assignments in this band as of March 1990. However, a frequency assignment in the government spectrum (NTIA-controlled) is different from one in the non-government (FCC-controlled) spectrum. Therefore, a simple comparison of the number of assignments in the government and non-government bands should not be used as a means to compare spectrum usage.

If the 1.71 - 1.85 GHz band is made available as a shared band with the government, frequency coordination could be quite difficult. Coordinating in bands shared with the government is generally time-consuming and inefficient.[22] Should this band be

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[22] Currently the 23 GHz band is shared with the government. When the FCC receives a 23 GHz application, a copy is sent to the Interdepartment Radio Advisory Committee (IRAC). If the application proposes to use spectrum that will impact with government operations, the IRAC returns the application to the FCC, whereby it is dismissed and returned to the applicant. The applicant is told only that the application may impact government operations in the band, and is not provided with other information on why the application was rejected. The applicant must then re-engineer the link to use a different frequency.

made available, the preponderance of requests for frequencies could overwhelm the system. Therefore, we urge the Commission to review the coordination procedures before considering the use of the 1.71 - 1.85 GHz band.

TRANSITION PLAN

The intent of the Commission's transition plan is to "reaccommodate the 2 GHz licensees in a manner that is most advantageous for these existing users, least disruptive to the public service, and most conducive to the introduction of new services." We believe that there are alternatives to relocation that will still fulfill the Commission's intentions.

Our studies and computer modelling indicate that it is not necessary to relocate all current users of the 2 GHz bands. By using the same techniques available to frequency coordination, we believe that substantial amounts of spectrum can be made available without relocating existing users. Therefore, we recommend that the Commission allow all current users of the 1.85 - 2.20 GHz band to remain co-primary indefinitely. The 10 - 15 year transition plan proposed is essentially the same as indefinite co-primary status, since within this period both new and existing users of the band would still have to address issues of sharing or migration in areas where PCS will initially be implemented. Also, over this 10 - 15 year period the market will prove the level of demand for PCS and be the driver for any transition that occurs in the 1.85 - 2.20 GHz band.

We have developed computer models which indicate that spectrum sharing is feasible between PCS systems and existing microwave systems in the 1.85 - 1.99 GHz band.[23] In addition, spectrum sharing can be accomplished to varying degrees in every MSA in the United States. However, in some MSA's there will be small areas where microwave operation is likely to be affected by PCS operation. Our modelling indicates that the sizes of these areas can be minimized or even eliminated through antenna and equipment upgrades, or by re-engineering the frequencies of key microwave paths. This indicates that it is possible to engineer a PCS system with the existing microwave environment.

This approach to sharing will permit a coordinated co-existence should the Commission decide to allow existing users to remain co-primary with new users. Through the use of negotiated arrangements and appropriate technical showings, new users could propose upgrades to affected microwave paths, subject to Commission approval. In situations where it is necessary to re-engineer the frequencies of selected key paths, new users could propose either frequencies within the 1.85 - 2.20 GHz that will not cause harmful interference (complete with the necessary antenna and equipment configurations), or propose to relocate them to any of the available relocation bands.

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[23] COMSEARCH is not alone in the development of spectrum sharing models. Telesis Technologies Laboratory, South West Bell, Motorola and others have all developed spectrum sharing models that have been described in their quarterly Experimental License reports to the FCC.

This approach will accommodate existing 2 GHz users in a manner that is most advantageous since the new users can propose coordinated upgrades to existing users' systems instead of relocating them. Relocation can be reserved for those key paths; and relocation to another band can be used as a final step if none of the other options is feasible. This also will minimize the disruption to the public. In addition, this will be conducive to the introduction of new services since these new service providers will be able to specify cost-effective alternatives to full-scale relocation.

The Commission has also requested comments on a phased approach to allocations of spectrum in the 1.85 - 2.20 GHz band. We believe that before considering the question of phased allocations, the Commission must determine how many service providers they will permit and what access technologies they will use. For example, the current access technologies being considered for PCS are Code Division Multiple Access (CDMA) and Time Division Multiple Access (TDMA). These access technologies each have different spectrum requirements depending upon the type of CDMA and TDMA being used.[24]

In addition, where in the band the allocations occur is important. For example, spectrum in the center of the 1.85 - 1.99 GHz band (between 1.91 - 1.93 GHz) is not as heavily used as

[24] For example, there are CDMA schemes that require 80 MHz, 48 MHz, 10 MHz, and 1.25 MHz to name a few. This access technology requires that this amount of spectrum be allocated all at once, since the CDMA schemes transmit across the entire block.

spectrum elsewhere in the band.[25] Therefore, anyone receiving an allocation in this portion of the band will realize an advantage, since there are likely to be fewer potential interference cases with existing users of the band.

The phased approach to allocating spectrum may well lessen the impact on existing fixed systems while ensuring the timely availability of new 2 GHz services. However, we urge the Commission to consider the issues mentioned above in making decisions on how to allocate spectrum.

[25] The channel parings and transmit/receive separations in this band concentrate the usage at each end of the band. Two 10 MHz channels, 1.915 and 1.925 GHz are allocated for one-way communications; however, these see limited use.

CONCLUSIONS

COMSEARCH is eager to see spectrum allocated to emerging telecommunications technologies. Our computer modelling and measurements indicate that through proper frequency coordination procedures, spectrum sharing can be accomplished between these emerging technologies and existing users in the 1.85 - 2.2 GHz band. To the extent that existing users wish to relocate from this band or that spectrum-sharing cannot be accomplished in certain areas, we believe that there is ample spectrum available in the fixed microwave bands above 3 GHz. We have provided the results of studies that indicate that microwave paths can indeed be migrated into other bands. Therefore, we urge the Commission to adopt rules that will both facilitate the introduction of these new emerging technologies, yet be sensitive to the needs of existing users.

Respectfully Submitted,
COMSEARCH

Prepared By: _____
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APPENDIX A

Count of Earth Stations in the Top 50 MSA's

CITY	T/R	R/O	T/O	4GHz	6GHz
New York	139	214	86	353	225
Los Angeles	103	217	77	320	180
Chicago	48	156	157	204	205
San Francisco	72	136	301	208	373
Philadelphia	69	199	72	268	141
Detroit	28	163	113	191	141
Boston	24	157	27	181	51
Washington	97	177	50	274	147
Dallas - Ft. Worth	71	144	218	215	289
Houston	54	165	259	219	313
Miami - Ft Lauderdale	25	117	23	142	48
Atlanta	41	111	29	152	70
Cleveland	17	123	43	140	60
Seattle - Tacoma	21	65	203	86	224
San Diego	16	55	29	71	45
Minneapolis - St Paul	32	77	145	109	177
St. Louis	41	93	110	134	151
Baltimore	102	199	61	301	163
Pittsburgh	13	197	62	210	75
Phoenix	60	65	115	125	175
Tampa - St Petersburg	16	98	13	114	29
Denver	73	81	182	154	255
Cincinnati	17	134	67	151	84
Milwaukee	12	101	71	113	83
Kansas City	28	77	157	105	185
Sacramento	51	117	166	168	217
Portland	8	53	127	61	135
Norfolk	13	39	23	52	36
Columbus	11	144	59	155	70
San Antonio	29	67	76	96	105
Indianapolis	13	115	37	128	50
New Orleans	11	62	26	73	37
Buffalo	4	61	39	65	43
Charlotte	9	100	22	109	31
Providence	22	139	31	161	53
Hartford- New Britain	58	147	46	205	104
Orlando	30	122	7	152	37
Salt Lake City- Ogden	26	41	100	67	126
Rochester	1	38	24	39	25
Nashville	9	68	21	77	30
Memphis	4	69	38	73	42
Oklahoma City	43	83	148	126	191
Louisville	4	81	28	85	32
Dayton- Springfield	22	169	86	191	108
Greensboro- Winstn Slm	8	108	21	116	29
Birmingham	3	79	18	82	21
Jacksonville	3	66	6	69	9
Albany- Schenectady	4	81	28	85	32
Richmond- Petersburg	6	71	10	77	16
West Palm Beach	21	125	22	146	43

APPENDIX B

Exploring Alternate Bands For 1.9 GHz Systems

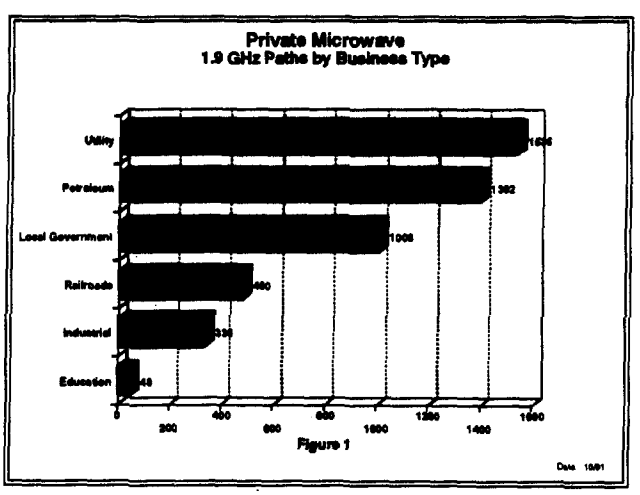
A Frequency Coordination Case Study

Comsearch, Reston, Virginia
January 20, 1992

Abstract

The 1850 - 1990 MHz allocation supports short, medium, and long haul network requirements of petroleum, utility, local government, railroad, and manufacturing users. The long-term investment in this band is reflected in the 4,800 microwave paths in service (Figure 1) covering 96,000 route miles supporting the equivalent of 3,000,000 voice circuits. Examples of critical traffic transmitted via these paths include petroleum production control, natural gas delivery management, nuclear power generation monitoring, public safety dispatch, railroad switching and signaling, and industrial robotics control.

This telecommunication infrastructure is at risk. Recent Federal Communications Commission proposals related to accommodating emerging micro-cellular technologies in the 1850 - 1990 MHz band threaten the continued use of this microwave service.



Introduction

Ongoing speculation surrounds the FCC public position on the future of the 1850 - 1990 MHz allocation. The FCC Notice of Inquiry released June 28, 1990 referenced the 1700 -2300 MHz band as a candidate for emerging micro-cellular technologies. The NOI also mentioned relocating 1850 - 1990 MHz systems in order to accommodate these emerging technologies. The prospect of displacement of 1850 - 1990 MHz paths looms as a major threat to microwave users. The American Petroleum Institute estimates it will cost $300 million to transition its members into other bands.[1] Extrapolation of API's estimate translates into a total cost of $1 billion to relocate all users of 1850 - 1990 MHz.

The FCC fueled speculation on displacing 1850 - 1990 MHz systems by proposing on January 16, 1992 to prioritize this band for emerging radio services. The FCC plans to require microwave users co-exist with the new radio services, relocate to higher frequency bands, or eventually be vulnerable to interference from these new services on a secondary, non-protected status.

As a result of the ongoing speculation surrounding the status of the 1850 - 1990 MHz band, this paper presents an independent, unsolicited engineering analysis that models the displacement threat mentioned above. This paper presents empirically derived conclusions in order to provide 1850 - 1990 MHz users, regulators, and spectrum managers insight into the frequency engineering considerations to transition these facilities into other bands.

Overview

Prior to exploring the frequency engineering considerations to transition existing 1.9 GHz systems into another band it was necessary to take the following steps:

1. Define a geographic area of concentrated 1.9 GHz utilization. This would establish the physical boundary and population of 1.9 GHz systems that would be considered in the transition simulation.

2. Identify an allocation of spectrum to transition the 1.9 GHz systems into. This transition band would be the environment for conducting interference prediction, interference analysis and resolution, and frequency coordination for the transitioned 1.9 GHz systems.

3. Require that the transition band also be experiencing concentrated frequency use for the geographic area identified above. This creates worst-case frequency engineering conditions for the transition model. The results obtained from modeling these worst-case conditions would indicate the degree of success or failure of the model in other geographic areas.

The geographic area satisfying these requirements was Houston, TX. The transition band identified for consideration was 6540 - 6870 MHz.

The following pages summarize the engineering methodology, results, and conclusions of the transition simulation.

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[1]Bob Wallace, "Users of Microwave Mixed on PCN Ruling." Network World, September 2, 1991, p. 12.

Houston, TX 1850 - 1990 MHz

A survey of the top twenty metropolitan statistical areas was conducted in order to determine microwave path counts for concentrated areas of 1.9 GHz deployment. The geographic areas surrounding Los Angeles and Houston reflect the highest path counts (Figure 2). Comparing these two geographic areas, Houston represented the highest density 1.9 GHz environment combined with the absence of significant terrain features. Lack of significant terrain dynamics in Houston would challenge the transition simulation by minimizing the degree to which terrain shielding could be employed in successfully transitioning 1.9 GHz systems to 6.7 GHz. This is in contrast to western regions of the country which have significant terrain dynamics.

A 65 mile radius surrounding Houston was defined as the area for simulating the transition of existing 1.9 GHz systems to 6.7 GHz. This radius insured a geographic area large enough to encompass likely micro-cellular systems of threat to 1.9 GHz microwave paths. The 65 mile radius was then expanded into a coordinate block in order to facilitate microwave route plotting and graphic presentations. The dimensions of this block translate to 28° 45' - 30° 45' N by 94° 15' - 96° 45' W, an area of 20,900 square miles.

The number of 1.9 GHz paths residing within this boundary totaled 107. Areas of concentrated 1.9 GHz utilization include the Houston central business district and petroleum processing and distribution areas located southeast of the city. Backbone routes are distributed throughout the boundary area.

The 1.9 GHz routes contained in the simulation boundary are distributed among 27 owners. These owners represent petroleum, railroad, local government, utility, and manufacturing sectors (Figure 3). Path length and analog/digital loading comparisons for these systems are contained in Figures 4 and 5.

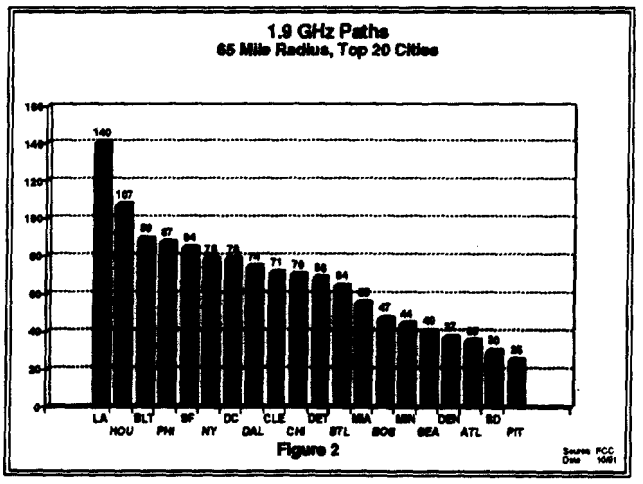

Figure 2

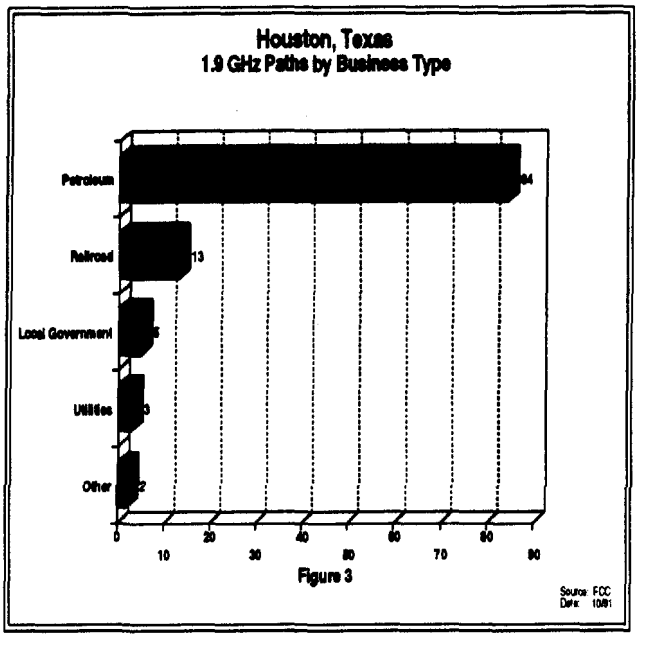

Figure 3

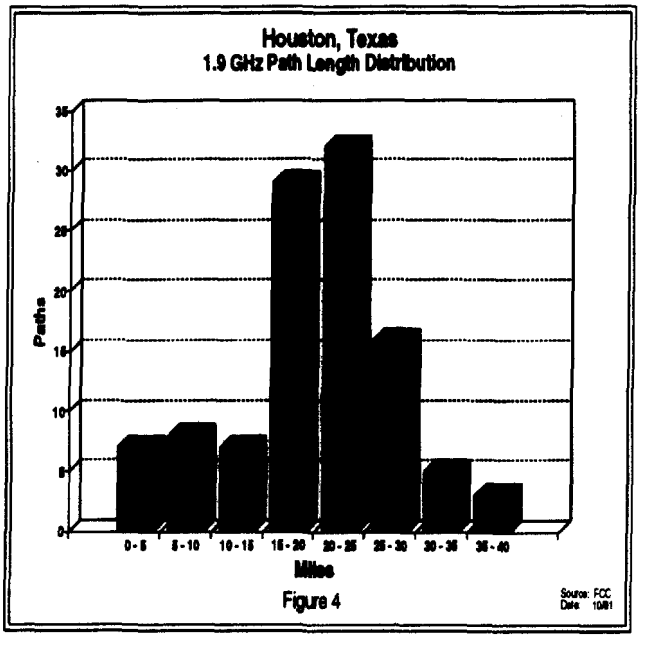

Figure 4